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C1C

Selected US specifications from IPC sub-class B01F

(54) **Dry powder dosing**

(57) Dry powder treatment material such as granular calcium hypochlorite or so-called "dry acid" is drawn by Venturi effect into a body of water taken off as a filtration stream from a swimming pool. The body of water is contained in a doser 10 and the Venturi 32 are operated by a jet of the pool water supply pumped by a pump 20 to a manifold 21. Valves 29 control the dosing in response to signals from a controller-recorder responding to a chlorine/pH sensor. The treatment material enters the manifold 21 in fluidized form with the result that entrained air enters the body of water in the doser. A conduit 26 takes off treated water which is returned to the pool and entrained air collected at a high point and is expelled via pipe 28.

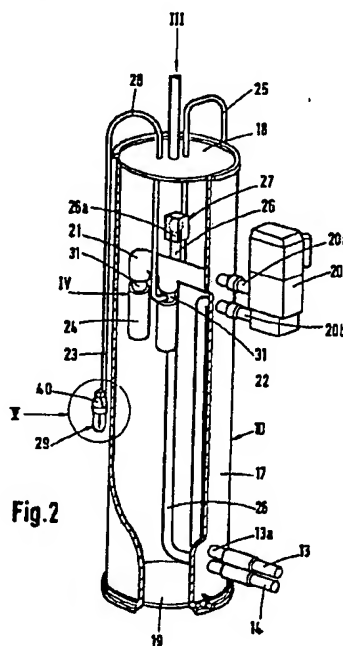


Fig. 2

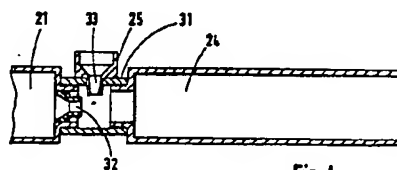


Fig. 4

The drawing(s) originally filed was/were informal and the print here reproduced is taken from a later filed formal copy.

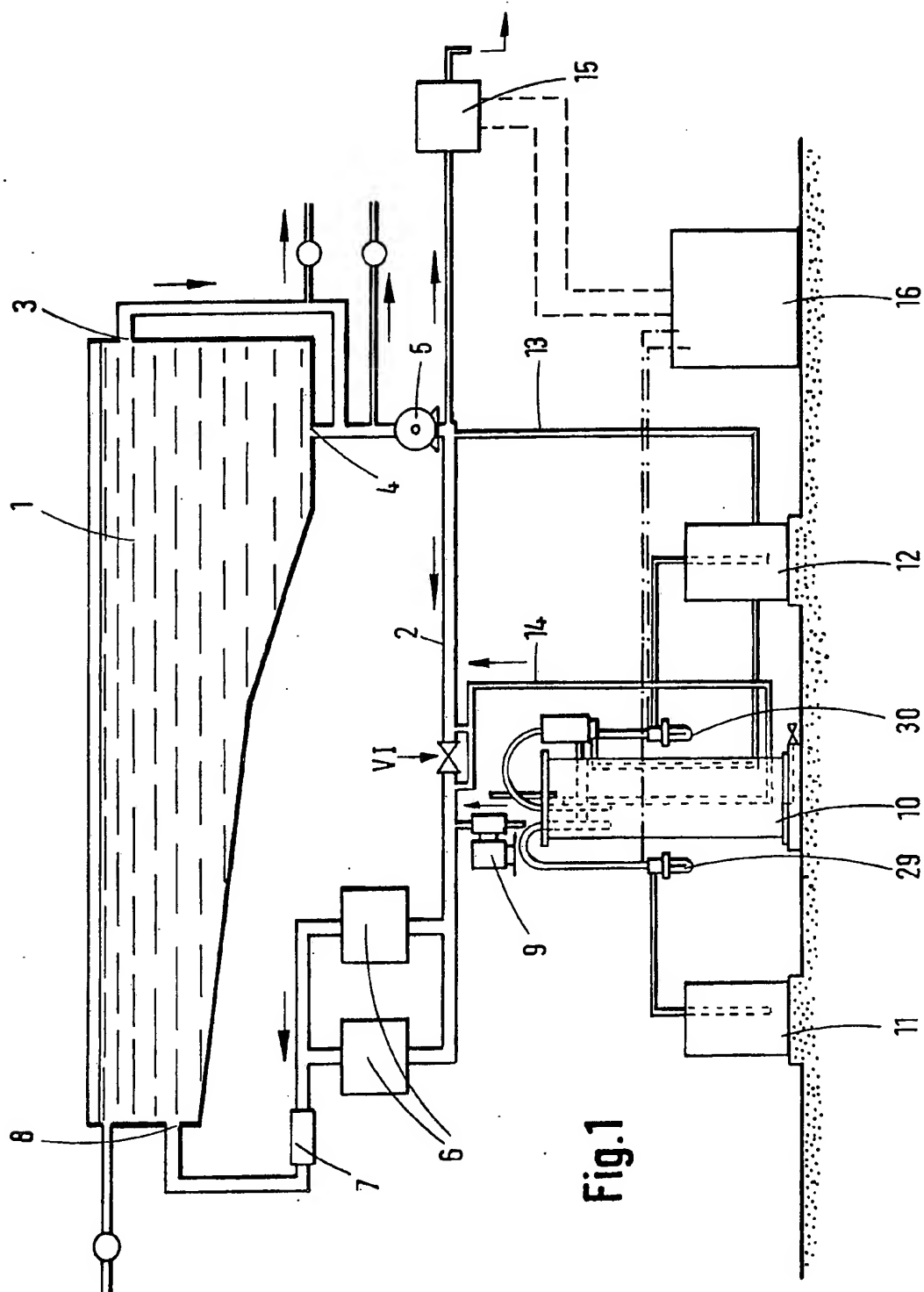
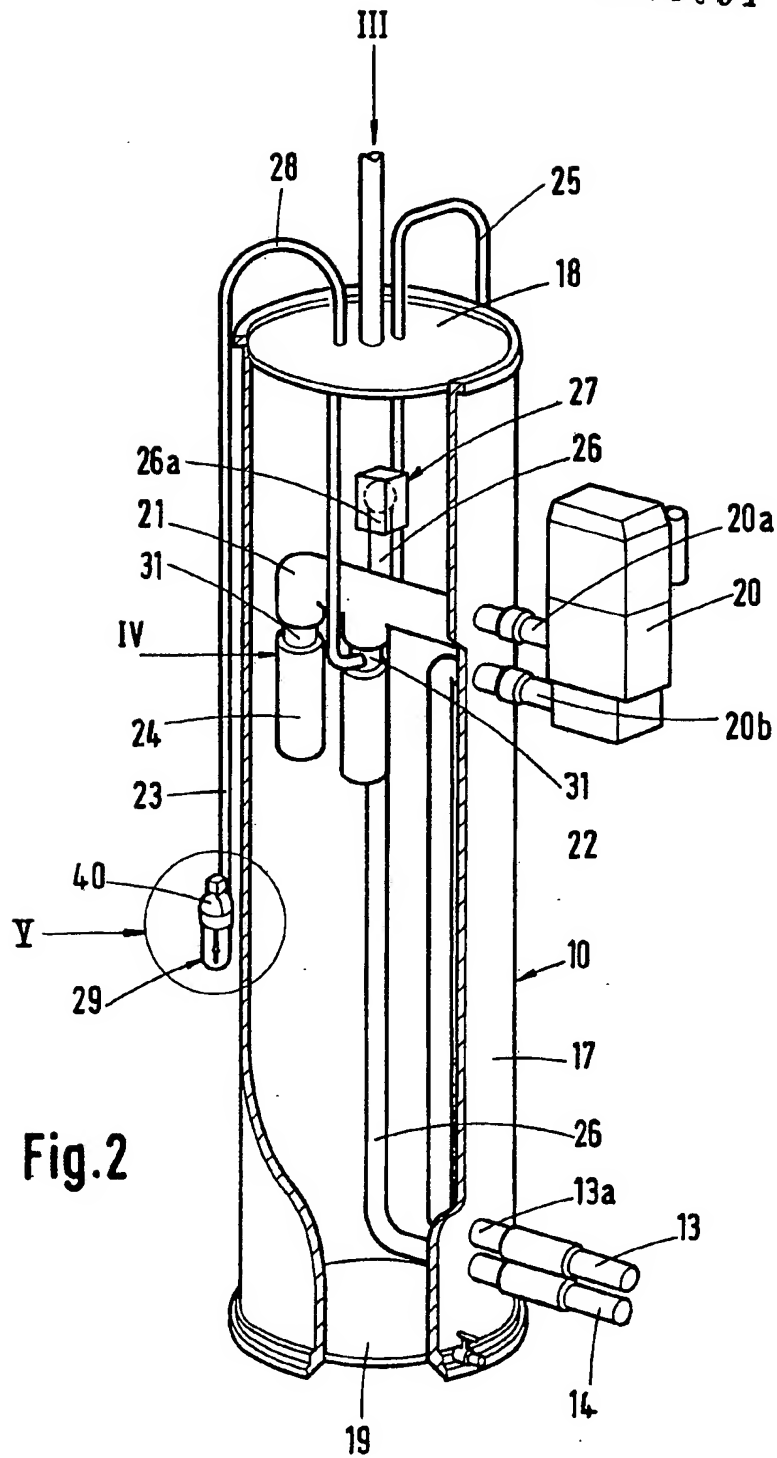


Fig.1



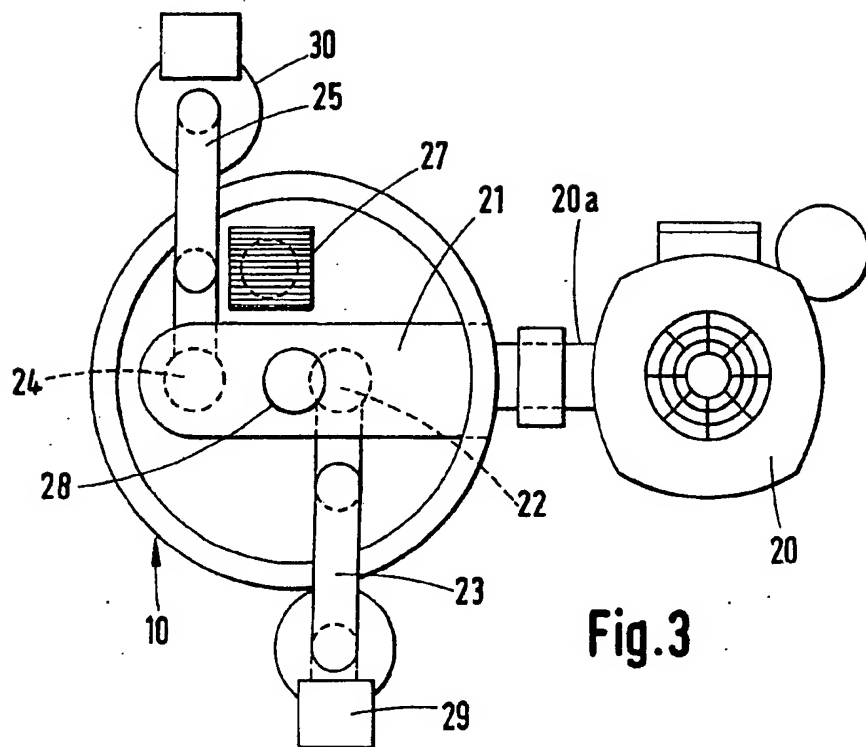


Fig. 3

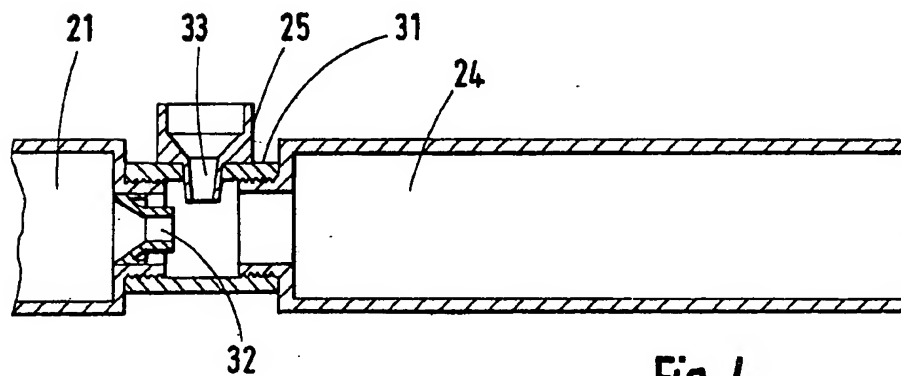


Fig. 4

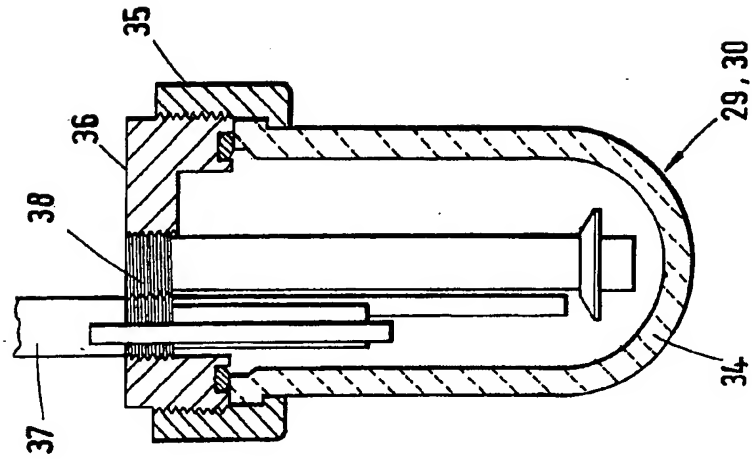


Fig. 5

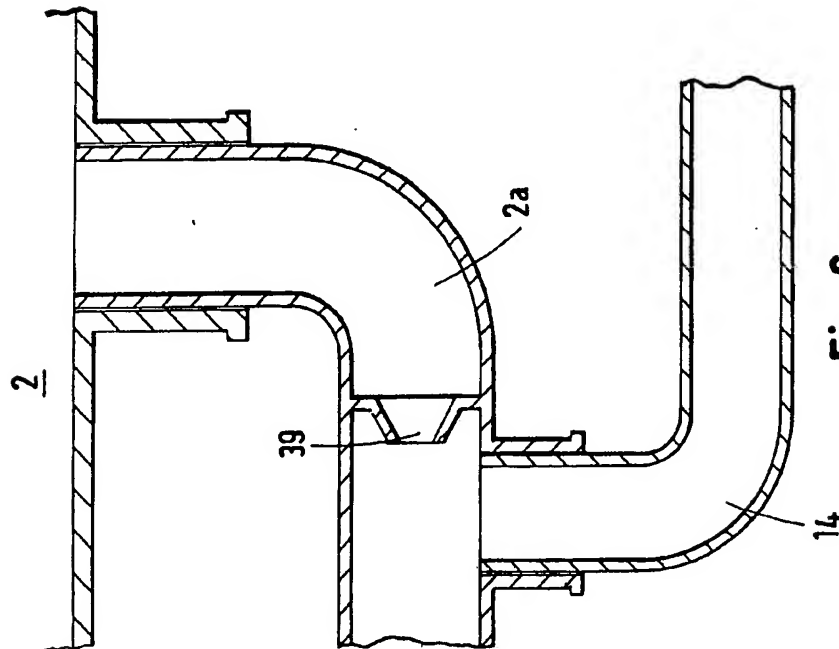


Fig. 6

## SPECIFICATION

## Dry powder doser

5 The invention relates to dry powder dosing into liquid streams and is particularly, but not exclusively, concerned with a method and apparatus for dosing dry powder treatment material such as hypochlorites and pH-adjusters into the filter stream of swimming pool water.

For reasons of hygiene, swimming pool water is normally treated by a process known as "chlorination" in order to render it biocidal in some degree. So-called "chlorinated" pool water, however, loses its chlorine content with time and use with the result that chlorination needs to be repeated at intervals in order to maintain a biocidally-effective chlorine content. Chlorination is usually effected by adding calcium hypochlorite or perhaps sodium dichloroisocyanurate dihydrate (or other chlorine source) to the pool water.

A filter stream of pool water is continuously taken off from the pool and returned after passing through a filtration system to remove pool debris. In practice, the chlorine source is most conveniently introduced to this stream.

The chlorine sources added to the pool water are solid materials available in dry powder particulate form. Dry powder form chlorine sources such as hypochlorites are hazardous corrosive materials since they readily dust and become airborne in significant quantities on handling, thus causing eye and respiratory irritation leading to discomfort and possibly impaired vision and breathing. These manifestations are, of course, evident in very small measure from exposure to chlorinated pool water itself even through the chlorine source is present at very high dilutions. Granule or tablet form chlorine sources are safer but still prone to dusting to a degree which makes their handling very hazardous; granule and tablet form additives are difficult to dissolve and therefore are unsuitable for direct dosing in conventional practice.

Avoidance of the need for human handling by sealed pump dosing is not a viable proposition in practice since the dry powder does not easily flow under pumping pressure. Thus, in conventional practice, dry powder chlorine sources such as calcium hypochlorite are first dissolved in an aqueous medium and the resulting solution introduced by pumping to the pool water filter stream. Although this practice has prevailed in the art over a large number of years, it has the major drawback that realistic amounts of powder require a relatively large volume of water to dissolve the solute, even at the high concentrations of dissolved material which have become customary in normal practice. This gives rise to the need for large storage tanks which are expensive in capital costs as well as maintenance and are, more-

over, unsightly in pool-side environments. Because high concentrations are usually adopted to minimize the frequency of recharging spent storage tanks, highly viscous chlorine source liquid is commonplace and this can produce pumping problems in cooler weather.

According to the invention, a dry powder dosing apparatus for dosing powder into a liquid stream such as pool filter stream comprises means defining a powder flow path between a powder inlet and a powder outlet, means for providing a decreasing pressure gradient from said inlet to said outlet so as in use to convey powder in fluidized form from a powder supply into the inlet and to the outlet and means defining a cavity into which the outlet opens to introduce fluidized powder into liquid of the stream contained in said cavity in use.

The pressure gradient normally is provided by exposing the powder outlet to a reduced pressure, such as by providing a Venturi constriction in its vicinity. Preferably, the cavity is arranged to receive the liquid stream through the Venturi to provide the pressure gradient between the powder inlet and outlet.

The Venturi (or other means of setting up the pressure gradient causes not only powder but gaseous material (ie normally air) to be conveyed through the powder outlet into the stream liquid in the cavity. The entrained gaseous material is desirably removed from the stream liquid in the cavity. Thus, in a preferred embodiment of the present invention, the apparatus includes means to remove from the liquid stream gaseous material entrained with the powder and conveyed along the pressure gradient to said cavity. The gaseous material removal means conveniently comprises means defining a reservoir for a body of stream liquid into which the stream is in use directed, and means for receiving separated rising entrained gaseous material at an upper region of said reservoir and for conveying said gaseous material from said reservoir. A liquid stream outlet conveniently opens at an orifice into the reservoir to take off liquid material for distribution, and such outlet is preferably provided with valve means for closing the orifice of said outlet in response to depression of the liquid level in the reservoir to the level of the orifice.

In one particular form of the invention a cavity having the powder outlet opening thereto has a downwardly-facing orifice and houses a downwardly-directed Venturi, the reservoir having a stream outlet for taking stream liquid therefrom as a continuation of said liquid stream. For example, the apparatus of the invention may comprise a first cavity for containing a body of stream liquid, a pump supplying stream liquid to a downwardly-directed Venturi disposed in a second cavity defined in an upper region of the first, the second cavity having a downwardly-facing orifice

into the first cavity and having the powder outlet opening thereto, an air exhaust conduit entering the first cavity at its top and a stream outlet having its orifice disposed above the outlet orifice of the second cavity but below that of the exhaust conduit.

The invention includes within its scope a swimming pool water treatment system comprising means defining a flow path for a pool liquid stream extending between a pool take off and a pool return outlet, the flow path having connected thereto a dry powder dosing apparatus of any of the forms described above.

In a further of its aspects, the invention provides a method of dosing dry powder treatment material such as a granular or other chlorine source (eg calcium or perhaps sodium hypochlorite or sodium dichloroisocyanurate) and/or pH adjuster to swimming pool water which methods comprises taking a stream of water from the pool or a remote source, introducing the stream into a cavity of a dry powder dosing apparatus, said cavity having an outlet of at least one treatment powder flow path opening therein, providing a decreasing pressure gradient from an inlet to said outlet of said powder flow path and thus conveying dry powder treatment material from a supply thereof (usually a manufacturer's container) perhaps forming part of the dosing apparatus, along said gradient to a body of the stream liquid contained in said cavity, and introducing the said powder/water in solution or dispersion form into the pool; the treatment material powder preferably leaves its outlet as a fluidized stream and in any event the powder will conveniently merge with a liquid (eg water such as pool water) stream (eg the stream just above mentioned) for example, as or just prior to bringing it together with the stream liquid contained in the cavity of the dosing apparatus. The method may use any of the dosing apparatus described therein.

In a preferred method, the stream is taken continuously from the pool during a phase of treatment and pumped continuously through a Venturi of the dosing apparatus in said phase so as to entrain dry powder treatment material and dissolve the latter therein, the resulting solution stream being fed continuously to the pool as a return stream.

The following is a specific description, by way of example only, of one preferred embodiment of the invention, reference being made to the accompanying drawings in which:-

Figure 1 shows in diagrammatic form the water filtration and treatment circuit of a swimming pool equipped with a dry powder doser according to the invention;

Figure 2 shows the dry powder doser of Fig. 1 on an enlarged scale and in more detail, part of the outer casing of the doser being shown partially cut away for this purpose.

Figure 3 is a plan view from the direction of the arrow 111 of Fig. 2, the depicted view being taken with the top part of the doser casing removed to expose internal detail.

Figure 4 is a cross-sectional view of the part of the doser encircled at IV in Fig. 2;

Figure 5 is a cross-sectional view on an enlarged scale and in more detail of the part of the doser encircled at V in Fig. 2; and

Figure 6 shows in more detail the structure of the part of the circuit indicated by the arrow VI in Fig. 1.

As shown in Fig. 1, the filtration/treatment system of a pool 1 comprises a doser 10 supplied via valves 29, 30 with calcium hypochlorite from tank 11 and dry acid pH adjuster from tank 12. Pool water is taken off from pool 1 by means of pump 5 via high level take-off 3 and low level take-off 4. The main take-off stream is pumped via return line 2 to filters 6 and calorifier 7 to return orifice 8 through which returned water re-enters the pool 1. A side stream of taken off pool water is pumped via line 13 to doser 10. An exit line 14 from doser 10 connects to the Venturi loop line 2a shown in detail in Fig. 6 and by this means re-introduces the side stream after passage through the doser to the return line 2, and thence to the pool 1. A further side stream is passed to pH/chlorine sensor 15 which signals detected pH levels and detected levels of residual chlorine in take-off water from the pool 1 to pH-residual chlorine controller-recorder 16. The latter is connected to operate valves 29, 30 to compensate for unacceptable pH and residual chlorine levels by opening tanks 11 and 12 to the doser 10 or isolating them from the doser.

Further side streams are taken off as shown in Fig. 1, for subsidiary purposes for example when a reduction in water level in pool 1 is required.

The doser 10 shown in detail in Fig. 2 comprises a sealed blow-moulded PVC hollow right circular cylinder having a cylindrical main casing 17 and top and bottom end plates 18, 19.

Line 13 couples to supply tube 13a of doser 10, tube 13a penetrating casing 17 at a low level and again at a high level to couple to pump 20 via inlet union 20b. Outlet union 20a of pump 20 connects the pump to manifold 21 disposed within the cavity of doser 10.

Manifold 21 has a pair of downwardly extending outlets terminating in reduced diameter portions 31 which couple the outlets to cylindrical open ended tubes 22, 24. Each reduced diameter portion 31 houses a Venturi 32 (Fig. 4) which directs pool water supplied via line 13 downwardly in a high speed jet. A pair of further Venturi 33 are disposed perpendicularly to the Venturi 32 one in each of the two reduced diameter portions 31 of manifold 21. Venturi 33 terminate powder supply lines 23,

25 which extend from valves 29, 30 and enter the cavity of doser 10 after penetrating top plate 18.

An outlet conduit 26 has an upwardly-facing orifice 26a controlled by a ball valve 27, the ball of the valve being buoyant so that the valve remains open as long as the level of liquid in the cavity of doser 10 is above the level of orifice 26a. Outlet conduit 26 extends downwardly to a point adjacent bottom plate 19 and then turns to penetrate casing 17 and couple to external line 14. Loop line 2a (Fig. 6) has a Venturi 39 in the flow path of take off pool water flowing from line 2 to the loop line. Line 14 connects to loop line 2a just downstream of Venturi 39 so as to provide a pressure gradient down from the orifice 26a of conduit 26 in doser 10.

Pipe 28 penetrates top plate 18 and acts as an air take-off from the cavity of doser 10.

Valve assemblies 29, 30 each comprise a sight glass 34, a valve body 40 and a closure system comprising a threaded rim member 35 which engages a shoulder of the sight glass 34 and a threaded plug 36 received within rim member 35. Powder supply line 37 connects via electrically operated valve body 40 to one or other of tanks 11 and 12 whilst supply tube 38 has a threaded union by means of which powder line 23 or 25 is connected to the sight glass 29. Controller 16 is in electrical connection with control means (not shown) of each valve assembly in order to provide for supply/termination of powder from tank 11/12 to the sight glass 34, the control means simply connecting the valve to atmosphere in supply termination conditions so that the pressure in line 23, 25 is relieved to atmosphere.

In use, the doser 10 is commissioned by first filling its cavity with water drawn from pool 1 and supplied via line 13, pump 20, manifold 21 and Venturi 32. Valves 29 and 30 are at this point kept in supply termination condition by manual override of controller 16. As pool water fills the doser cavity, air is expelled via pipe 28.

On reaching a full condition of the doser cavity, manual override controller 16 is removed so that a chlorine deficiency or unacceptably high pH level detected by sensor 15 causes controller 16 to respond normally by signalling valve 29, 30 to adopt a powder supply condition. Continued pumping of pool water by pump 20 through manifold 21 and Venturi 32 thus provides a pressure gradient from the valve to the tube 22, 24 which is not relieved to atmosphere but is instead applied through the valve to the powder supply line 37 and tank 11, 12. This causes powder to be drawn into the supply line and via the valve to the Venturi 33 through which the powder passes in fluidized form and is entrained in the jet stream of water exiting Venturi 32.

The pool water stream entraining dry powder treatment material (and fluidizing air drawn into the system via an air inlet to the tank 11, 12) is conveyed into the body of pool water already contained in the doser cavity and distributed throughout this body of water by the force of the jet stream. Due largely to the size of the body of water in the doser cavity and partly to the remote position of outlet orifice 26a relative to the bulk of the newly entering treated pool water, treated water has a real residence time in the doser which ensures dissolution of treatment powder before the treated water leaves the doser and reaches the filtration system 6 and calorifier 7 of the pool 1.

Because of the fluidized nature of the powder feed entering manifold 21, entrained air enters the doser 10. The entrained air is initially finely distributed throughout the body of water in the doser 10 but rapidly the air bubbles coalesce and rise to the top of the doser cavity where air collects and is expelled through pipe 28. The pressure gradient provided by Venturi 39 (Fig. 6) draws treated water out of the doser 10 via outlet orifice 26a and outlet conduit 26 to external line 14, the pressure gradient very slightly more than compensating for the input pressure to the doser through Venturi manifold 21. Entrained air is generally in the form of large and therefore rapidly rising bubbles at the elevation of orifice 26a in the doser cavity so that the liquid stream entering conduit 26 contains little entrained air to interfere with the filtration and heating system and enter the pool 1. Periodically, the volume of air separated from entrainment is sufficiently large that the level of liquid in the doser cavity falls to the level of outlet orifice 26a of outlet conduit 26. In such event, the ball of ball valve 27 seals orifice 26a and prevents air from entering the return line 2 of the pool recycle system.

The doser according to the invention performs to provide a very efficient and convenient means of dosing dry powder treatment material to pool water. Because powder is a highly concentrated form of treatment additive, large supply tanks conventionally required for dosing of liquid additives are avoided and the doser itself is relatively compact and unobtrusive, typically having a height of about 1 metre for pool sizes commonly found in public swimming pool facilities in UK. At the same time, the additive is introduced without the hazards associated with airborne additives and without the attendant problems of difficult dissolution which are commonly experienced when converting powder to liquid concentrated solution form.

Although the expression "dry powder" is used therein, the powder may, of course, contain moisture and the expression is used merely as a convenient term widely used in the art to denote the fact that the treatment



material is used in solid flowable particulate form rather than as the liquid form normally used, as will be appreciated from the foregoing description, after first dissolving the solids in a supply of aqueous medium. The "dry powder" may be a granule form of the solid treatment material, a convenient granule size being 0.5 to 1mm. It has been found that granular material has much improved solubility when disposed in pool water in accordance with the invention due to distribution throughout a body of water and consequent exposure to high dilution under dynamic conditions.

The invention as described earlier without reference to the drawings may include any one or more features of the invention as described with reference to the drawings. For example, any of the dosing apparatus described earlier without reference to the drawings may include a stream outlet connected to any source of reduced pressure, such as a Venturi. Such a Venturi may be disposed, for example, in the stream supply to the cavity of the dosing apparatus as by providing the Venturi in the take off line from a pool.

#### CLAIMS

1. A dry dosing apparatus for dosing powder into a liquid stream which apparatus comprises means defining a powder flow path between a powder inlet and a powder outlet, means for providing a decreasing pressure gradient from said inlet to said outlet so as in use to convey powder in fluidized form from a powder supply into the inlet and to the outlet and means defining a cavity into which the outlet opens to introduce fluidized powder into liquid of the stream contained in said cavity in use.

2. An apparatus as claimed in Claim 1 wherein the means for providing the pressure gradient is a Venturi.

3. An apparatus as claimed in Claim 2 wherein the cavity is arranged to receive the liquid stream through the Venturi to provide the pressure gradient between the powder inlet and outlet.

4. An apparatus as claimed in any one of Claims 1 to 3 wherein means is provided to remove from the liquid stream gaseous material entrained with the powder and conveyed along the pressure gradient to said cavity.

5. An apparatus as claimed in Claim 4 wherein the gaseous material removal means comprises means defining a reservoir for a body of stream liquid into which the stream is in use directed, and means for receiving separated rising entrained gaseous material at an upper region of said reservoir and for conveying said gaseous material from said reservoir.

6. An apparatus as claimed in Claim 5 wherein a cavity having the powder outlet opening thereto has a downwardly-facing orifice and houses a downwardly-directed Venturi, the reservoir having a stream outlet for

taking stream liquid therefrom as a continuation of said liquid stream.

7. An apparatus as claimed in any preceding claim and comprising a first cavity for containing a body of stream liquid, a pump supplying stream liquid to a downwardly-directed Venturi disposed in a second cavity defined in an upper region of the first, the second cavity having a downwardly-facing orifice into the first cavity and having the powder outlet opening thereto, an air exhaust conduit entering the first cavity at its top and a stream outlet having its orifice disposed above the outlet orifice of the second cavity but below that of the exhaust conduit.

8. An apparatus as claimed in any one of Claims 1 to 3 and comprising at least two powder flow paths and at least two associated powder inlets and outlets whereby two different powders can be dosed into the liquid stream simultaneously.

9. A dry powder dosing apparatus substantially as hereinbefore described with reference to, and as illustrated in, the accompanying drawings.

10. A swimming pool water treatment system comprising means defining a flow path for a pool liquid stream extending between a pool take off and a pool return outlet, the flow path having a dry powder dosing apparatus as claimed in any preceding claim so connected thereto that said stream enters the cavity of said dosing apparatus.

11. A swimming pool water treatment system as claimed in claim 5 wherein a side stream is taken off from the pool liquid stream and directed to the cavity of said dosing apparatus.

12. A swimming pool water treatment system substantially as hereinbefore described with reference to, and as illustrated in, Fig. 1 of the accompanying drawings.

13. A method of dosing dry powder treatment material to swimming pool water which method comprises taking a stream of water from the pool or a remote source, introducing the stream into a cavity of a dry powder dosing apparatus, said cavity having an outlet of at least one treatment powder flow path opening therein, providing a decreasing pressure gradient from an inlet to said outlet of said powder flow path and thus conveying dry powder treatment material from a supply thereof forming part of the dosing apparatus along said gradient to the stream liquid in said cavity, and introducing the resulting powder/water in solution or dispersion form into the pool.

14. A method as claimed in Claim 13 wherein said decreasing pressure gradient is provided by applying reduced pressure to the outlet of said powder flow path.

15. A method as claimed in Claim 14 wherein said reduced pressure is produced by passage of a fluid stream.

16. A method as claimed in Claim 15 wherein said reduced pressure is produced by passage of a stream of pool water into which said convyed powder treatment material is entrained.

17. A method as claimed in any one of Claims 13 to 16 wherein the stream is taken continuously from the pool during a phase of treatment and pumped continuously through a Venturi of the dosing apparatus so as to entrain dry powder treatment material and form a solution or dispersion of the latter in pool water in the cavity of the dosing apparatus, the resulting solution stream being fed continuously to the pool as a return stream.

18. A method as claimed in any one of Claims 13 to 17 wherein first and/or second dry powder treatment material flow paths are connected to the dosing apparatus, the first dry powder material being a chlorine source and the second dry powder material being a pH-reducing material.

19. A method of dosing dry powder treatment material to swimming pool water, substantially as hereinbefore described with reference to the accompanying drawings.

20. A swimming pool water treatment system comprising means defining a flow path for pool liquid stream extending between a pool take off and pool a return outlet, a dry powder dosing apparatus as claimed in any one of Claims 1 to 12 connected to the flow path to receive liquid therefrom, a Venturi operated by pool liquid take-off flow and disposed externally of the dosing apparatus and an outlet for treated liquid from the dosing apparatus, said outlet being connected to the locus of the Venturi so that reduced pressure at the connection draws treated liquid from the dosing apparatus to said connection.

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